



ORIGINAL PAPER

Macronutrient Intake and Life Style Factors Associated to HbA1c Status in Type-2 Diabetic Patients

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Abstract

Background: This study aims to determine the relationship between macronutrients intake and lifestyle factors to HbA1c status of type-2 diabetic patients in improving the effectiveness of patient's nutritional support therapy and preventing diabetic complications.

Methods: Type-2 diabetic patients were categorized into 2 groups, i.e. patients with good glycemic control with HbA1c < 7.0 and patients with poor glycemic control with HbA1c ≥ 7.0. Data collection included clinical characteristics (i.e. age, gender, body mass index, duration of illness, type and amount of diabetic medication, and diabetic complication). Macronutrient intake consisted of total daily calories and carbohydrate, protein, fat and fiber intakes, while lifestyle factors consisted of the adherence to dietary advice and medication, physical activities, smoking habit, and alcohol intake. The relationships between all data to HbA1c status were analyzed using Chi Square test.

Results: Younger type-2 diabetic patients (<55 years old), carbohydrate intake, and adherence to dietary advice had statistically significant in related to HbA1c status ($p < 0.05$).

Conclusions: Health and nutrition education should be provided to the younger age of type-2 diabetic patients to maintain proper dietary pattern following to medical nutrition therapy.

Keywords HbA1c status, lifestyle, macronutrient intake

Introduction

Approximately 90% of worldwide Diabetes Mellitus (DM) patients are having type-2 Diabetes Mellitus (T2DM). Diabetes Mellitus has become an epidemic in recent years. In year 2000, around 150 millions people in the world suffered from DM, and it was estimated to reach 300 millions in the

year 2025. Developing countries in Asia, South America, and Africa are expected to have the biggest increase in T2DM patients.^{1,2} Based on data from Health Research and Development of Indonesia Ministry of Health the prevalence of T2DM patients and impaired glucose tolerant patients in Indonesia in 2008 is 5.7% and 10.25%, respectively. By 2020, the prevalence of T2DM patients in Indonesia is estimated to be 8.2 millions of 178 millions citizen with age above 20 years old.³

Numerous extensive clinical studies demonstrate that strict control of blood glucose level correlates with the reduction of micro-

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vascular complication risk. American Diabetes Association (ADA) and American Association of Clinical Endocrinologist (AACE) have set a target of HbA1c less than 6.5% as the optimum glycemic control. Despite the evidence of various studies which reveal the benefits of intensive treatment to reduce the risk of micro- and macro-vascular complications for diabetic patients, the number of patients with poor glycemic control remains high. T2DM patients with poor glycemic control are becoming a public health issue because they have higher risk to develop diabetes complications in the future.^{4,5} For Indonesian, the Indonesian Society of Endocrinologist (*Perkumpulan Endokrinologi Indonesia*/ PERKENI) has set a target for HbA1c less than 7.0% as the optimum glycemic control.⁶

Glycemic control is still one of the therapeutic target to prevent major organ damage and other complications for DM patients. During clinical treatment, it is difficult to reach optimum glycemic level in a long-term basis for T2DM patients due to complex reasons. The main reason for poor glycemic control is DM patients' low understanding on the long-term dietary benefits. Results from cross-sectional studies indicate low compliance to dietary recommendation which includes macronutrient intake and fruit and vegetable consumption.⁷ Hu et al⁸ followed 84,941 female nurses between year 1980 and 1996 (The Nurses' Health Study) and concluded that obesity was the major important predictor of diabetes, while lack of exercises, poor diet, smoking habit, and alcohol intake were also associated with the risk increase in developing diabetes. Rawal et al⁹ examined nine publications about the prevention of T2DM and its complications which were conducted in developing countries. The studies concluded that non-pharmacological intervention and lifestyle change were found to be effective in reducing the risk of developing T2DM in patients with impaired glucose tolerance and improving the glycemic control of T2DM patients. This study was done to determine the relationship between macronutrient intake and lifestyle factors to HbA1c status of type-2 diabetic patients who attended Diabetes Clinic in Husada Hospital Jakarta, Indonesia.

Methods

This is a cross sectional study that recruited type-2 diabetic patients who attended Diabetes Clinic in Husada Hospital Jakarta between April to May 2015 by consecutive sampling. The eligibility criteria including over 18 years old, male or female T2DM patients who had medical nutrient therapy for minimum three months, and willing to participate in the study. Patients who were pregnant, breastfeeding mother, had moderate or severe anemia, and/or unable to stand or walk were excluded. All subjects had given informed consent to participate in the study. Sample size was determined by using rule of thumb in analyzing difference in two proportions by having a minimal total sample of 40 subjects.

Approval from the Ethics Committee of Faculty Medicine of University of Indonesia was released before conducting the data collection. Individual interview was held to collect age, gender, the duration of illness, type and amount of diabetic medications, other diabetic complications, and physical activities data. Macronutrient intake pattern (total daily calories and carbohydrate, protein, fat and fiber intake) of at least 1 month were analyzed using semi-quantitative Food Frequency Questionnaire (FFQ). Lifestyle data were collected to assess the adherence to medicine intake, smoking habit, and alcohol intake using 1x 24-hour food recall. Food intake information was disaggregated, converted, and averaged into daily nutrient intake using a computer analysis program called Nutrisurvey 2007. Body mass index (BMI) was calculated as weight in kilograms (SECA scale) divided by the square of height in meters (Microtoise stature meter), the result was then categorized according to Asia-Pacific BMI classification. Glycemic control of HbA1c was analyzed using high performance liquid chromatography, D-10, and the hemoglobin using flow-cytometry (Sysmex).

All statistical analyses were performed using SPSS software package version 20 program. All categorical data were presented as proportions. Chi Square test was used to examine the relationship between macronutrient composition intake and lifestyle factors to HbA1c status. A p-value of <0.05 was considered as statistically significant.

Results:

Clinical Characteristics

This study included 57 T2DM patients whose age between 40 to 79 years old, with median age of 55 years old, median BMI of 26.9 kg/m² (19.0–45.4), median duration of illness of 5 years (1–30 years), and mean (SD) of haemoglobin of 12.8±1.3 g/dl.

Among all clinical characteristics variables studied, i.e. age, gender, BMI, duration of illness, type and amount of diabetic medication consumed, and other diabetic complications, only age was significantly related to HbA1c (p-value=0.012, see Table 1). This study shows that subjects less than 55 years old had a significantly poor glycemic control (Hb1Ac ≥7.0) compared to those among older age.

Macronutrient intake

Table 2 shows that approximately 10% of the subjects had high daily calorie intake compared to the PERKENI recommendation. This condition can be related to the high proportion of subjects had high fat intake. However, only carbohydrate intake that significantly associated to HbA1c status, in which high carbohydrate intake was only found among those with poor glycemic control (p-value=0.032). PERKENI macronutrient ratio recommendation are carbohydrate 45–65%, protein 10–20%, and lipid 20–25%⁶.

Table 1 Clinical characteristics of study subjects and HbA1c status

Clinical Characteristics	Frequency (%)	HbA1c status		P-value (chi-square test)
		<7.0 (n=26)	≥7.0 (n=31)	
Age, years				
18–55	29 (50.8)	8	21	0.012
>55	28 (49.2)	18	10	
Gender				
Male	11 (19.3)	6	5	0.745
Female	46 (80.7)	20	26	
BMI, kg/m ²				
<18.5	-	-	-	0.727
18.5–22.9	11 (19.3)	4	7	
23–24.9	14 (24.6)	8	6	
25–29.9	15 (26.3)	9	6	
≥30	17 (29.8)	5	12	
Duration of diabetes				
<5	28 (49.2)	16	12	0.147
≥5	29 (50.8)	10	19	
Diabetes treatment				
None	3 (5.3)	3	-	0.792
OHO	49 (85.9)	21	28	
Insulin	3 (5.3)	1	2	
Combination	2 (3.5)	1	1	
Amount of diabetic medicine				
None	3 (5.3)	3	-	0.169
1	21 (36.8)	11	10	
>1	33 (57.9)	12	21	
Diabetic complication				
None	6 (10.5)	3	3	0.576
Yes	51 (89.5)	23	28	

Table 2 Macronutrient intake of study subject and HbA1c status

Macronutrient intake	Frequency (%)	HbA1c status		P value (chi-square test)
		<7.0 (n=26)	≥7.0 (n=31)	
Daily calorie intake, % the recommendation				
<90	26 (45.6)	11	15	0.523
90–110	25 (43.8)	13	12	
>110	6 (10.6)	2	4	
Carbohydrate (C), % total calorie				
<45	15 (26.3)	8	6	0.032
45–60	37 (64.9)	18	20	
>60	5 (8.8)	-	5	
Protein (P), % total calorie				
<10	-	-	-	0.499
10–20	52 (91.2)	23	29	
>20	5 (8.8)	3	2	
Fat (F), % total calorie				
<20	1 (1.8)	-	1	0.103
20–25	2 (3.5)	-	2	
>25	54 (94.7)	26	28	
Fiber, g				
<20	2 (3.5)	-	2	0.187
20–25	21 (36.8)	7	14	
>25	34 (59.7)	19	15	
C, P, F ratio, % total calorie		47:18:35	51:16:33	

Lifestyle

Approximately 54.4% subjects had good adherence to dietary advice and performed light activities, while 86% subjects had good adherence to medication, only 7% were active smokers, and none were consuming alcohol.

Physical activity categories were based on Compendium of Physical Activities (light MET <3, moderate MET 3–6, heavy MET>6).¹⁰ Table 3 shows a significant relationship between adherence to diet and HbA1c status (p-value=0.004), in which those not adhered to diet had higher proportion of poor glycemic control.

Table 3 Life style of study subjects and HbA1c status

Life style Characteristics	Frequency (%)	HbA1c status		P value (chi-square test)
		<7.0 (n=26)	≥7.0 (n=31)	
Adherence to diet				
Yes	31 (54.4)	20	11	0.004
No	26 (44.6)	6	20	
Physical activity				
Light (MET <3)	31 (44.6)	12	19	0.381
Moderate/heavy (MET >3)	26 (54.4)	14	12	
Adherence to medication				
Yes	49 (85.9)	22	27	0.142
Not taking it	3 (5.3)	3	-	
No	5 (8.8)	1	4	
Smoking				
Yes	4 (7.0)	1	3	0.376
No	53 (93.0)	25	28	

MET: metabolic equivalent

Discussions

This study shows that age, carbohydrate intake and adherence to diet had significant relationships to HbA1c status of type-2 diabetic patients in Diabetes Clinic of Husada Hospital Jakarta. By age category, Karakelides,¹¹ stated that there is age-related decline in insulin sensitivity which is secondary to age-related changes in body composition (central obesity); and that a longer duration of DM is related to the increase in insulin resistance.⁵ Longer duration of the disease will reduce insulin endogen, thus T2DM patients would need multiple medicines to control their blood glucose level.¹² Woo¹³ stated that higher intake of protein, lipid, zinc, and vitamin E affected good glycaemic control significantly, and macronutrient composition intake in elder diabetic patient was better in good glycemic (60:20:20) compared to poor glycaemic control patients (71:15:15).

Most diabetic patients were reducing their carbohydrate-sourced foods in order to lower their total daily calorie intake. This study shows that although there was no statistically significant relationships between protein, fat, and fiber intake to HbA1c status, subjects who had high carbohydrate intake significantly had poor glycemic control. This is in accordance to the fact that medical nutrition therapy is necessary in preventing diabetes, managing existing diabetes, and preventing or delaying the rate of developing diabetes complications.¹⁴ In addition to macronutrients intake, adherence to diet had statistically significant relationship to HbA1c status.

Study Limitation

This study had recall bias threat in duration of diabetes and disease complications, because the data recorded were from patients' self-report without further validation from physical examination and laboratory finding.

Conclusion

In conclusion, younger type-2 diabetic patients (age <55 year old) and patients with HbA1c level $\geq 7.0\%$ are recommended to be well informed about their

diet, especially with regards to type of macronutrient-rich foods.

Conflict of Interest

Authors declared no conflict of interest regarding this study.

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